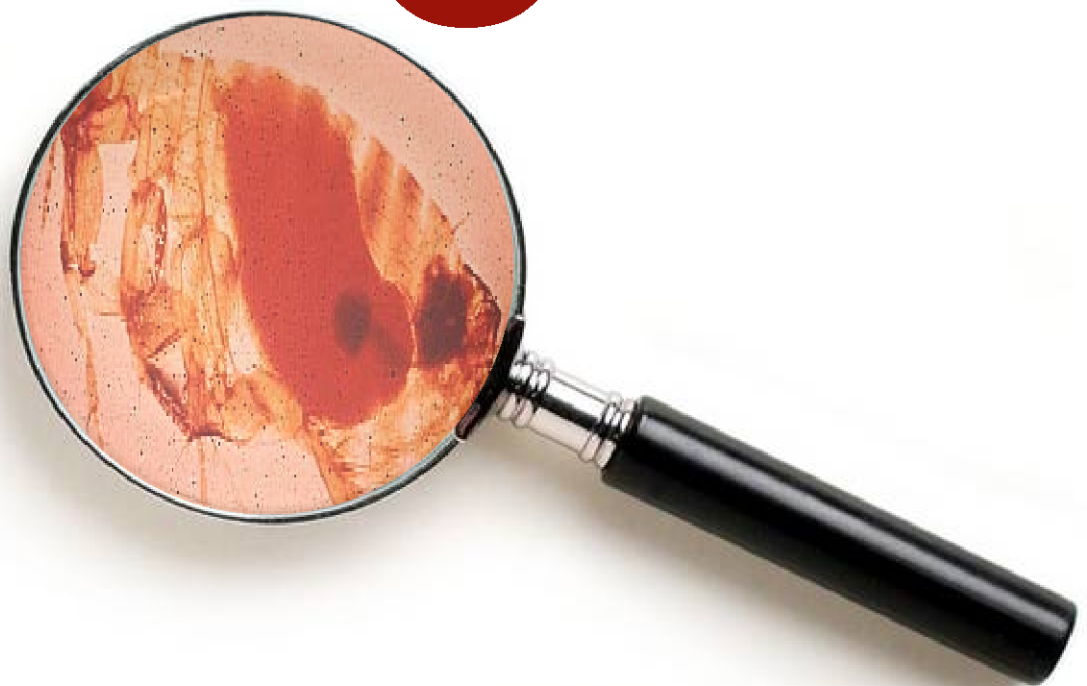


frequently **a**sked **q**uestions on
plague



frequently asked questions on plague

What is plague?

Plague is an infectious disease of rodents and humans caused by a germ *Yersinia pestis*. This germ is found in rodents and their fleas in many areas of the world.

Fig. 1: Plague bacteria (*Yersinia pestis*)



Why is plague considered a dreadful disease?

The world has seen widespread epidemics of plague for ages. It continues to be a life threatening disease unless detected and treated early. Plague organism secrete several toxins and some of them are highly toxic and life threatening. Untreated bubonic plague has a case fatality rate of about 50%-60%. Untreated primary septicaemic plague and pneumonic plague are almost invariably fatal.

In 1994, there was a pneumonic plague epidemic in Surat, India, causing 54 deaths and the migration of about 300,000 residents who fled from the affected areas.

Epidemiology

Geographically where does plague occur?

Significant plague foci exist in Asia, Africa and in North and South America. Each of these surviving natural foci is maintained by transmission of *Y. pestis*



among wild rodents and their fleas. It was considered a rural disease but now there are reports of outbreaks in urban settings in some countries.

Fig.2: Global distribution of natural plague foci (in rodent populations)



What is the magnitude of plague?

Between 1998 and 2008, more than 23 278 cases of human plague were reported including 2116 fatalities in 11 countries. More than 95% of cases were reported from Africa. This disease may have caused over 200 million deaths in the history of humanity. The disease continued to be a major public health problem until the mid-1940s.

Is plague a problem of developing countries?

No. The disease occurs in all countries with natural foci of plague. The disease is also reported from developed countries like USA etc.

Which countries have reported plague in recent years from the South-East Asia Region?

Indonesia reported a plague outbreak in Pasuruan district of East Java Province in February 2007. India reported an outbreak of pneumonic plague in February 2002 in Himachal Pradesh. A localised outbreak of bubonic plague occurred in Dangud village district Uttarkashi, Uttarakhand in October, 2004.

What are the conditions that can lead to a major epidemic?

Major epidemics are most likely to occur when rats living in close association with humans come in contact with the wild rodent reservoirs of plague. A large population of these rats, and infestation with vector fleas, aids the spread. Usually these conditions are found in poverty-stricken areas with poor sanitation. Major outbreaks of pneumonic plague are most likely to occur in crowded localities. Cool temperatures facilitate transmission.

Who should be contacted in case of a suspected plague outbreak?

Plague is a notifiable disease in many countries. Being a disease of international importance, any case in non-endemic areas should immediately be brought to the notice district/state authorities so that effective steps can be initiated at the earliest. Negligence at the time of focal outbreak may lead to a public health disaster.

What are the criteria of international notification of plague outbreak under IHR (2005)?

The occurrence of a suspect case in an area not known to be endemic for plague is an event to be notified to WHO in accordance with the revised International Health Regulations (2005). This notification triggers a verification process that includes the consultation of an expert committee. The expert committee may confirm the occurrence of plague based on the available evidence and additional laboratory investigations may be recommended.

What is notification and denotification?

Notification means reporting immediately on reasonable suspicion by the fastest possible way – email, fax, phone or if this is not available, through police networks or local media networks or private parties.

Denotification means reporting at the end of two incubation periods ($7 \times 2 = 14$ days), after the last case has either recovered or died.

What is the period of active surveillance, after outbreak is controlled?

For a minimum of two incubation periods i.e. 14 days after the last case has recovered or died.

Vector and reservoirs

What is the natural reservoir for plague?

Plague is maintained in nature as an infection of certain species of wild rodents and their fleas. Wild rodents, the natural reservoir of plague, are found in mountains, deserts, cultivated areas, and forests in temperate and tropical regions. At least 220 species of rodents are known to be infected with plague bacillus. Among the commensal rodents *Rattus rattus* and *Mus musculus* are hosts for *Y.pestis*. In India, the wild rodent *Tatera indica* has been incriminated as the main reservoir.

Fig. 3: Wild rodent (*Tatera indica*)



What is the role of cats and dogs in the transmission of plague?

Among domestic animals, cats are severely affected by *Y. pestis* infection. They can develop all three forms of plague. Five instances of primary plague pneumonia through cat-to-human transmission have been recorded. Dogs seem to be somewhat resistant to *Y. pestis* infection. If they do become ill, it will be a brief, self-limiting disease.

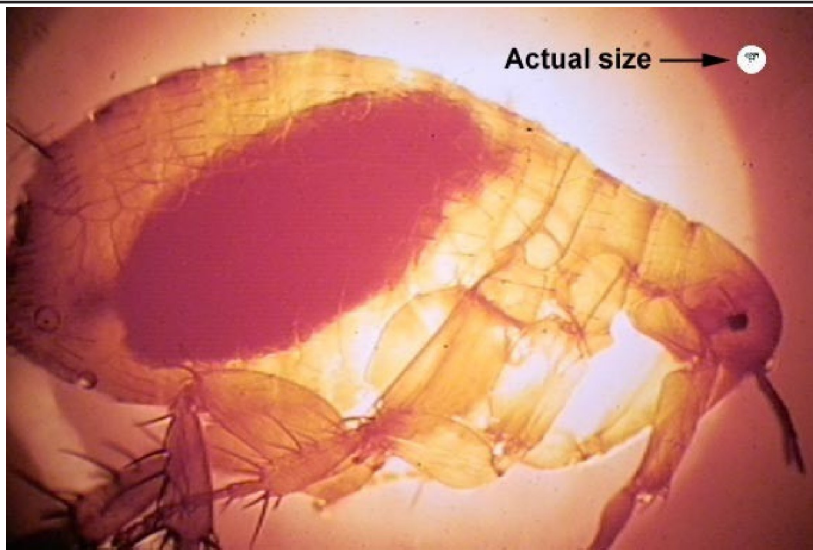
Why are dogs used for plague surveillance?

Dogs are used as a sentinel animal for plague surveillance since they consume rodent prey or are likely to scavenge fresh rodent carcasses. Wild and domestic dogs typically survive plague infection and develop antibodies that can be detected for as long as six months. Therefore, it is important to collect serum samples from dogs in order to detect evidence of plague activity.

What are the vectors of plague?

Fleas are the natural vectors of plague. There are 3000 fleas of which at least 31 are proven vectors of plague. On a global basis, the most significant vector species is the oriental rat flea (*Xenopsylla cheopis*), which lives on commensal rats of the genus *Rattus*. This flea species has been the primary vector in almost all of the world's major flea-borne plague epidemics. Infected fleas can maintain *Y.pestis* for weeks to months under conditions favourable for flea survival (high humidity and moderate temperatures).

Fig. 4: Oriental rat flea (*Xenopsylla cheopis*)



What is rat fall?

More than one house with dead rats where it has been ascertained that death among the rats was not due to poisoning.

Why plague surveillance is important?

Natural decline in human plague incidence would not justify the conclusion that plague has disappeared from the area. The natural foci of plague are known to be maintained in wild rodents in a cyclic pattern. The sudden ecological changes might create a spill over of sylvatic plague into domestic environment. Recent outbreaks have shown that plague may re-emerge in areas after a long period of silence.

How plague surveillance is carried out?

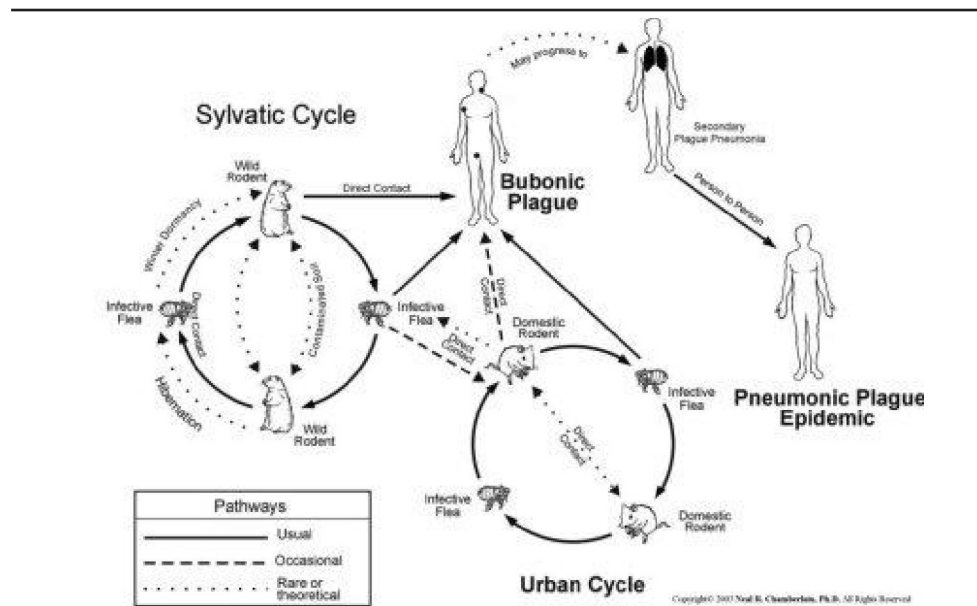
Plague surveillance requires laboratory support for evidence of plague activity in rodents, carnivores, fleas and humans. Fleas are processed for identification, calculation of flea index and isolation of plague bacilli. Serological investigations are carried out for detection of antibodies in rodent and human sera. One of the most powerful techniques for detecting evidence of plague activity is to collect serum samples from carnivores that consume rodent prey or are likely to scavenge fresh rodent carcasses.

Mode of transmission

What is the basic transmission cycle of plague?

Fleas become infected by feeding on rodents, like ground squirrels, mice, rats and other mammals that are infected with the bacteria *Yersinia pestis*. Fleas transmit the plague bacteria to humans and other mammals during the feeding process. The plague bacteria are maintained in the blood systems of rodents.

Fig. 5: Plague transmission cycle



Is the disease seasonal in its occurrence?

No, plague can be acquired at anytime during the year.

How do people get plague?

Human plague is most frequently contracted in the following ways:

- By the bite of fleas infected with the plague bacteria.
- By direct contact with infected tissues or fluids from handling sick or dead animals.
- By droplet infection from cats and humans with pneumonic plague.

All ages and both sexes are susceptible to plague.

Can one get plague from another person?

Yes, when any person having pneumonic plague coughs, droplets containing the plague bacteria are released into the air. A non-infected person can inhale these droplets and get infected.

Can an infected person transmit plague to others before symptoms appear?

Person-to-person transmission in the absence of symptoms is extremely unlikely. However, persons in close contact with pneumonic plague patients who are coughing are at risk of infection through exposure to bacteria-laden droplets.

Clinical signs and symptoms

How soon after exposure would symptoms begin (incubation period)?

The incubation period for bubonic plague is usually 2-7 days, but occasionally it can be longer. Symptoms in pneumonic plague cases appear in less than one day or up to four days following inhalation exposure to *Y. pestis*.

What are the different forms of plague?

There are three major clinical forms of the disease:

- Bubonic,
- Septicaemic, and
- Pneumonic

There are a few other rare manifestations of plague, including meningial, and pharyngeal plague.

What are the clinical signs and symptoms of plague?

Infected persons usually start with “flu-like” symptoms after an incubation period of 1-7 days. Patients typically experience the sudden onset of fever, chills, head and body-aches and weakness, vomiting and nausea. Clinical plague infection manifests itself in three forms depending on the route of infection: bubonic, septicaemic and pneumonic.

How can we clinically recognize different forms of human plague?

The classical signs and symptoms of bubonic, septicaemic and pneumonic plague are as follows:

Bubonic plague: enlarged, painful lymph glands (the swollen gland is called a “bubo”, hence the term “bubonic plague”), fever, chills, and prostration.

Fig. 6: A patient with bubonic plague (Inguinal Bubo)



Fig. 7: A patient with bubonic plague (Axillary Bubo)



Septicaemic plague: fever, chills, prostration, abdominal pain, shock and bleeding into skin and other organs.

Pneumonic plague: fever, chills, cough and difficulty in breathing, rapid shock and death if not treated early.

What are the other human diseases mimic to bubonic or pneumonic plague?

Bubonic plague may be confused with streptococcal or staphylococcal lymphadenitis, infectious mononucleosis, cat-scratch fever, lymphatic filariasis, tick typhus, tularaemia and other causes of acute lymphadenopathy.

Pneumonic plague may be confused with other cases of acute, severe community-acquired pneumonia, such as pneumococcal, streptococcal, *Haemophilus influenzae*, anthrax, tularaemia, *Legionella pneumophila*, leptospiral, hantavirus pulmonary syndrome, and influenza virus pneumonia. Regional lymphadenitis may indicate plague or tularaemia pneumonia arising secondary to a cutaneous infective exposure.

Therefore, local epidemiological conditions and other communicable diseases should be taken into account for differential diagnosis of human plague.

Diagnosis and confirmation

What samples should be taken for laboratory diagnosis of human plague?

Blood samples should be taken for investigation of all types of human plague. Serum taken during the early and late stages of infection (paired serum samples) can be examined to confirm infection. In addition, bubo fluids/aspirates must be taken for bubonic plague whereas a throat swab and sputum must be taken for pneumonic plague. If a post-mortem has been carried out, it is recommended to take samples of lymphnodes, lungs, spleen, bone marrow and liver.

What precautions should be taken while collecting laboratory samples?

Personal safety is important while handling potentially dangerous infected materials.

The following precautions should be applied:

- Follow strict aseptic technique (gowns, gloves, masks).
- Wash hands before and after the collection of material.
- Place the specimen aseptically in an appropriate sterile container.
- Tightly close the container.
- Label and date the container.

How should transportation of samples from the field to the laboratory be arranged?

Cary-Blair transport medium is used for the transport of all clinical and autopsy material with the exception of blood collected for bacteriological and serological studies. Blood culture bottles and bottles with sera should be sent directly to the laboratory.

What are the standard laboratory tests to diagnose plague?

Plague organisms can be detected by Fluorescent Antibody Assays, isolation of the bacteria on microbiological media, enzyme immunoassays, agglutination assays and, polymerase chain reaction assays (PCR).

Serodiagnosis is usually made by using passive hemagglutination or enzyme immunoassays.

Is there a rapid diagnostic test for plague?

Rapid dipstick tests have been validated for field use to quickly screen for *Y. pestis* antigen in patients. However, specimens should be forwarded to laboratories for confirmatory diagnosis and antibiotic sensitivity test.

How is a plague case confirmed?

Confirmation of plague requires laboratory testing. Recovery and identification of *Y.pestis* culture from a patient sample is optimum for confirmation.

How much time is needed for confirmatory diagnosis of plague?

Specimen processing and testing takes at least 72 hours for confirmation of plague. However, if suspected, control measures should be instituted pending the availability of laboratory results.

Are the diagnostic facilities for confirmation of plague available?

The diagnostic facilities to confirm plague are available in countries with natural foci.

Is it safe to transport clinical samples of a suspected plague case from the field to the laboratory through public transport?

Clinical samples of plague are highly infectious. If packed and transported as per WHO recommendations in triple containers, it is safe to transport samples through public transport system.

Case management

Can plague be treated?

A fatal disease in the pre-antibiotic era, modern therapy has markedly reduced fatalities. Plague can be treated successfully if treatment is initiated early and the success of treatment depends on the type of human plague. Early case detection and early treatment is important.

What is the basic treatment?

Antibiotic therapy is the basis of treatment. Streptomycin is the drug of choice. Alternative antibiotics include gentamycin, tetracycline, doxycycline, chloramphenicol, trimethoprim and sulfamethoxazole. Treatment of plague in mass casualty setting is 10 days.

What are the treatment guidelines?

Start antibiotic immediately on suspicion of plague.

If a referral hospital with an isolation ward is easily accessible, preference would be to transfer the patient to this hospital.

All suspected cases should be preferably isolated individually; if this not possible, the isolation should be done for the same cluster cohorts (same symptoms/same date of onset) after ensuring proper droplet isolation.

What are the guidelines for transportation of patients?

Transportation of pneumonic plague suspects should be restricted and their dispersal prevented.

If transportation is required, the patients as well as the personnel transporting them should use special masks and the vehicle used should be disinfected with appropriate antiseptics/disinfectants.

When should a patient be discharged?

For both bubonic/pneumonic plague: 48 hours after a 10-day course of appropriate antibiotic is complete and evidence of clinical recovery (cessation of symptoms).

Prevention and control

How can plague outbreaks be controlled and prevented?

Outbreaks of flea-borne plague can be controlled by applying insecticides and by reducing the amount of food and shelter available for plague-susceptible rodents. Rodent populations can be decreased through proper sanitation. A combined approach using the following preventive methods is recommended for bubonic plague:

- environmental sanitation;

- rodent and vector control by using insecticides;
- preventive antibiotic therapy (chemoprophylaxis) to contacts;
- educating the public on ways to prevent exposure to plague, and
- active surveillance.

Pneumonic plague outbreaks can be controlled by quickly identifying the cases and providing them with antibiotic therapy.

What is the chemoprophylaxis of plague?

Doxycycline is the drug of choice for chemoprophylaxis. The drug should be given 100 – 200 mg orally 12-or 24-hourly for seven days from date of last exposure. However, tetracycline or chloramphenicol can also be used. Tetracycline and doxycycline should not be used in children less than eight years. Children younger than two years should not receive chloramphenicol.

Is there any vaccine available?

Inactivated plague vaccine is no longer commercially available. However, live attenuated and formalin killed *Y. pestis* vaccines are available. It does not protect against primary pneumonic plague. Further vaccination is of little use during human plague outbreaks, since a month or more is required to develop a protective immune response.

How should the bodies of plague patients be disposed of?

Disposal of bodies as per local religious tradition (cremation or burial) is accepted. However, handling of the bodies must be done aseptically i.e. use of masks, gloves, preferably by trained people. If burial is the custom, the grave should be deep enough and rodent-proof.

What are the guidelines for a funeral?

In principle, should be avoided mass gathering and a private recommended funeral. All those who intend to attend the funeral must receive chemoprophylaxis. Post-funeral ceremonies involving a mass gathering should be prevented; a private ceremony should be recommended; all people who intend attending the ceremony should receive chemoprophylaxis.

Should rodents be killed during an outbreak?

No. The fleas leaving the dead rodents will bite human beings thereby increasing the transmission of the disease to the human population.

